MASS TRANSFER DURING THE DISSOLUTION OF MILK POWDER UNDER THE CAVITATION MODE

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Dairy products are socially significant and play an important role in the diet of humans. Because of high dependence of milk production on raw material factor, the amount of dry milk in the production of dairy drinks is good enough. The upgrading of the technology of dairy beverages production taking advantage of new technologies and equipment make possible to intensify production, improve the nutritional value and consumer properties of dairy products, reduce the consumption of raw materials.

The problem of dry milk protein dissolution is, that solid phase particles, the sizes of which are within d <0.1 mm, stick together while dissolving and form clusters of 1–3 mm sizes, which dissolve slowly. In such a case, cavitation effects can cause intensification of the process.

The research on the dissolution of the milk powder in separated milk has been conducted by the author. The options for the duration of treatment: 120, 240, 360, 480, 600 sec. in the temperature range from T = (20 ± 0,5) °C to T = (65 ± 0,5) °C have been analyzed. Samples of separate milk with acidity 17, 19, 21ºT have been used in the experiments. All controlled output parameters of powder milk dissolution were studied before and after the experiment, which made possible to make a conclusion as to the degree of cavitation-cumulative impact on the process of dissolution.

The obtained results confirm outer-diffusion kinetics of dissolution when the intensity of dissolution is determined by the supplying speed of fresh reagent to the surface of solids. A slight decrease in the dissolution intensity under the temperature 60 °C as compared with the kinetics under the temperature 45 °C occurs due to the fact, that under such conditions starts coagulation of whey protein is initiated and therefore the solubility decreases.

The acidity of the milk does not have sufficient impact on the process of dissolution. To assess the speed of the process under the cavitation mode mass transfer coefficients were determined according to the method described. The results are shown in Fig. Under various process conditions the decrease of the coefficient β over time is observed. This change can be explained by the formation of small size particles due to clusters breaking, which, in turn, can be caught by the flow of liquid or vapor-gas phase.

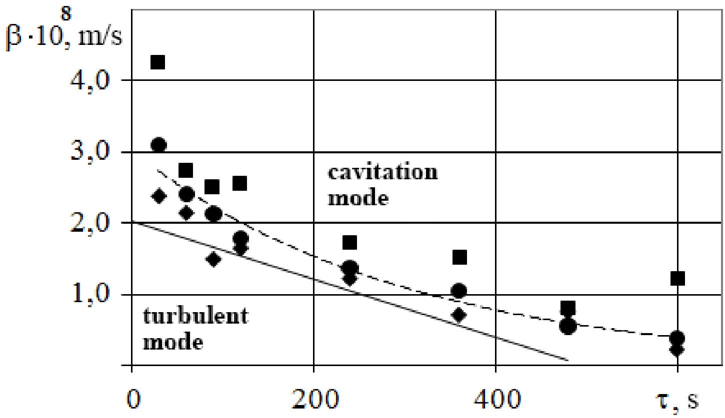

Fig. Dependence of mass transfer coefficient on the time of dissolution at different temperatures T: ◆ – 20 °C, ■– 45 °C, ● – 60 °C

The change of mass transfer coefficient under the cavitation mode is described by the equation obtained by summarizing experimental values β (Fig.)

$$\beta = 3 \cdot 10^{-8} e^{-0.0035\tau}$$

Within the possible error (15%), this equation should be used to predict the dissolution process under the Reynolds number in the range of Re=(2,4–4)·10^5 and in the temperature range T = (20…65) ºC.